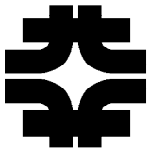

Fermi National Accelerator Laboratory

PIXEL DETECTOR PROJECT

MITEL VCSEL ARRAY TESTS

Document # ESE-PIX-?????

-PRELIMINARY-

May, 1999

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Test of the Mitel 4D469 VCSEL array (4 Channels)

The tests on the VCSEL array were performed with the common cathode connected to ground and a variable voltage supply on each anode via 30 ohms. The measurements of the optical power from the VCSEL were made using a PIN array 4D470 via MT-12 connectors and optical fiber ribbon (12 fibers), a Multimeter Fluke 76 to measure the current in the VCSEL and a Tektronix PS2521G programmable power supply.

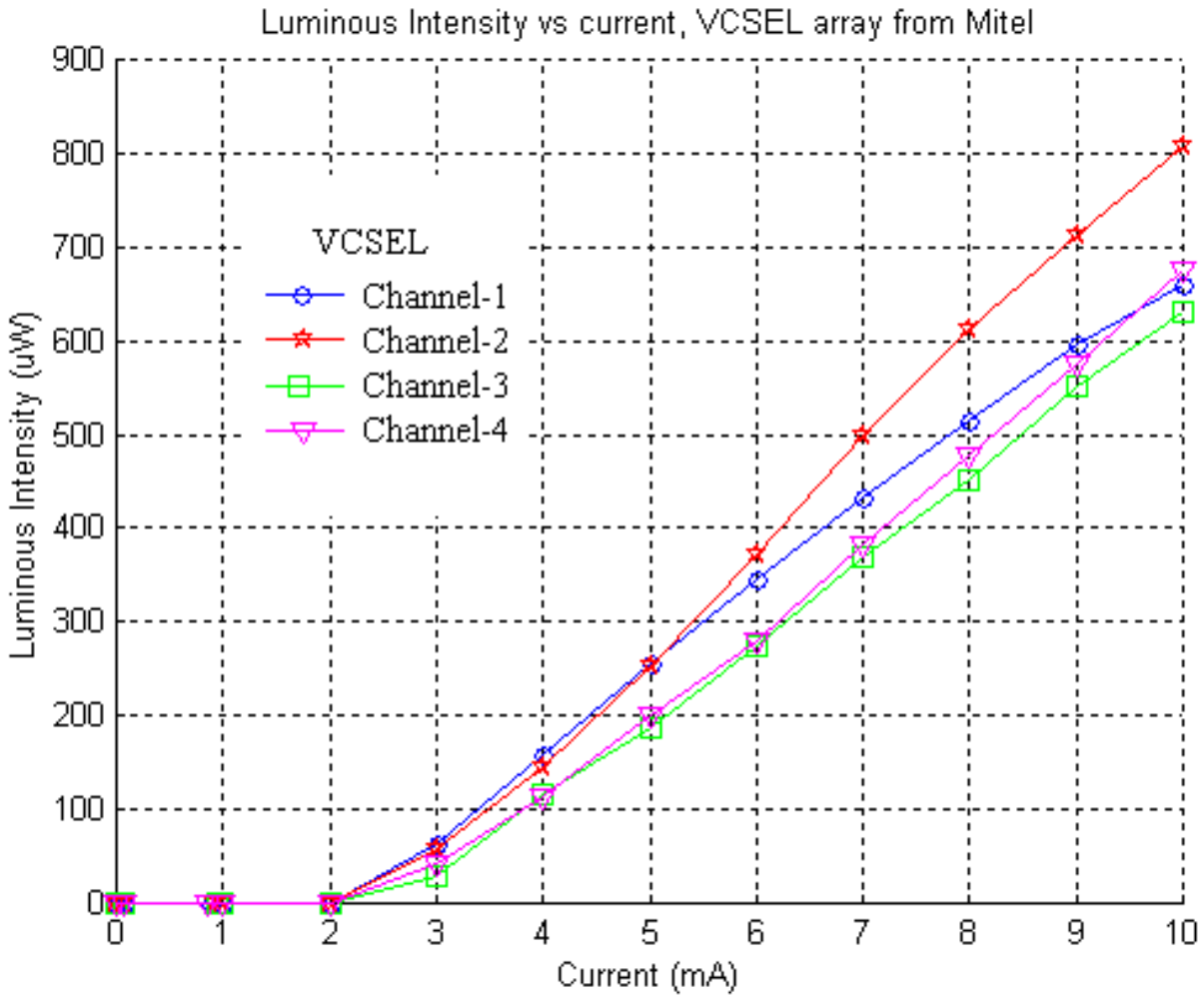

Figure 1: Relationship between the Luminous intensity delivered to each PIN of the array and the current flowing in each VCSEL of the array. The VCSEL array and the PIN array were connected via MT-12 connectors and optical fiber ribbon (12 fibers).

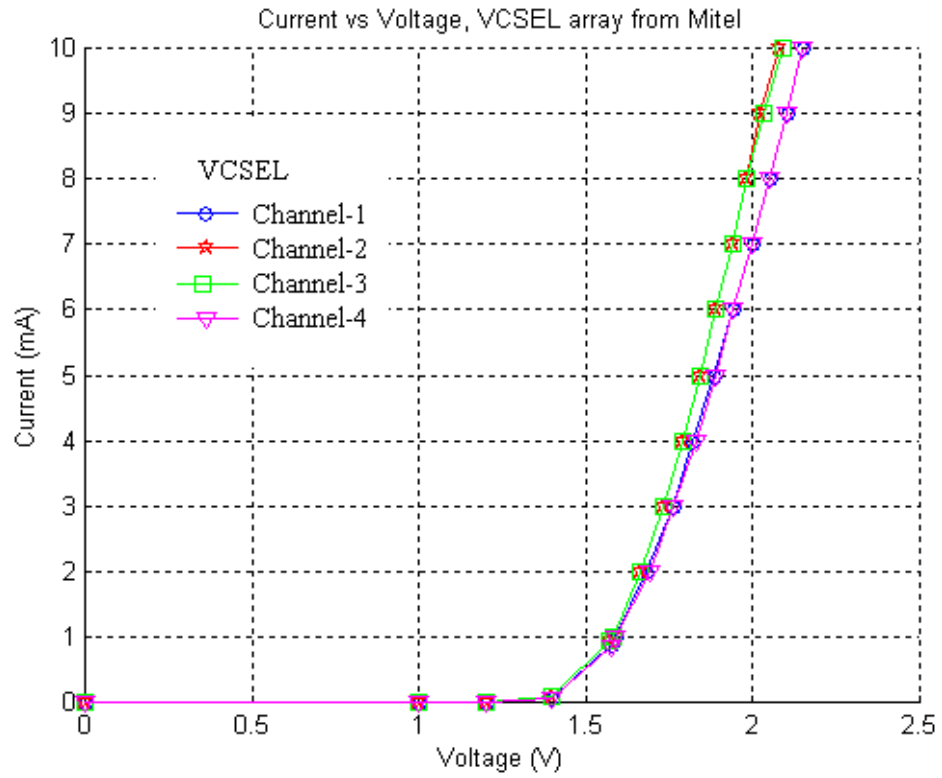

Figure 2: Relationship between the current flowing in each VCSEL of the array and its voltage.

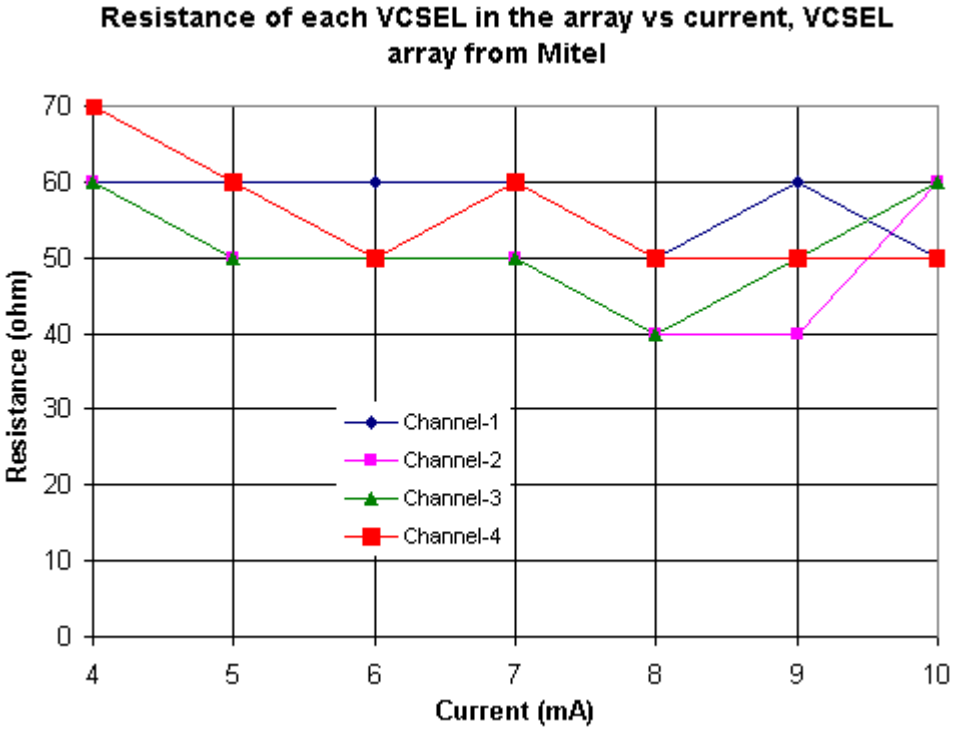

Figure 3: Relationship between the current flowing in each VCSEL of the array and its resistance.

Test of Crosstalk on the Mitel 4D470 PIN array (4-Channel)

The tests were performed with the common cathodes connected to ground via 30 ohms and the anode connected to ground via 50 ohms as a load. Measurements were made using a Keithley 485 autoranging picoammeter and a Mitel 4D469 VCSEL array as the light source for each channel.

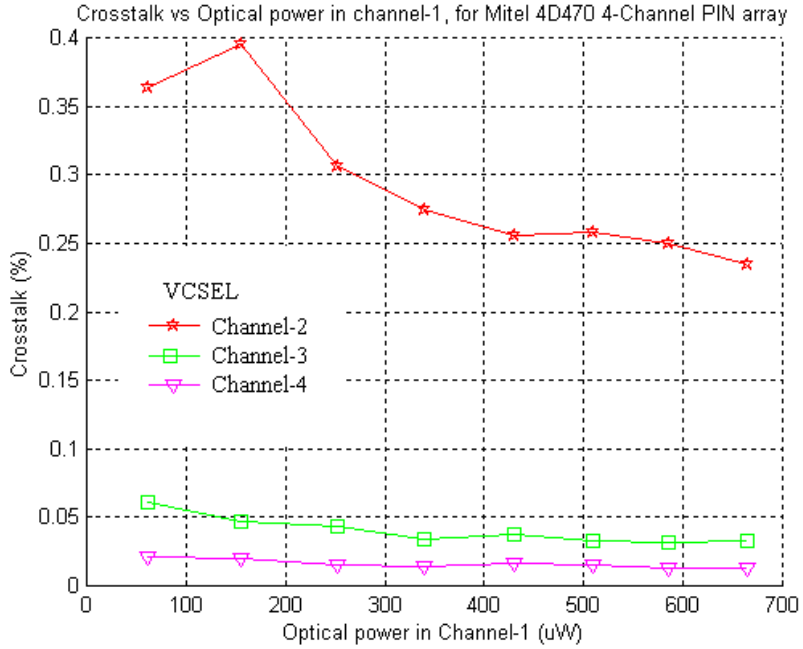

Figure 4: Crosstalk at the channels of the PIN array produced by the optical power received in the channel-1.

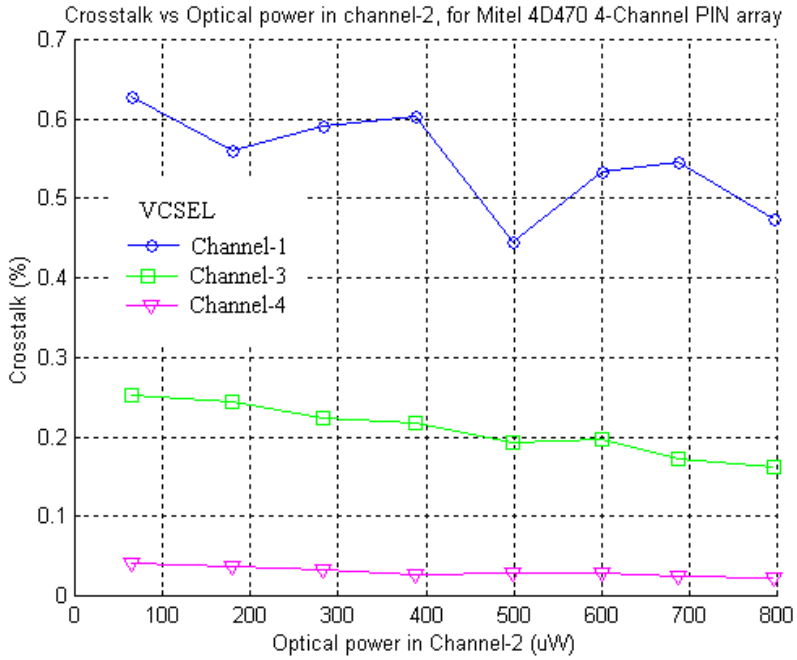

Figure 5: Crosstalk at the channels of the PIN array produced by the optical power received in the channel-2.

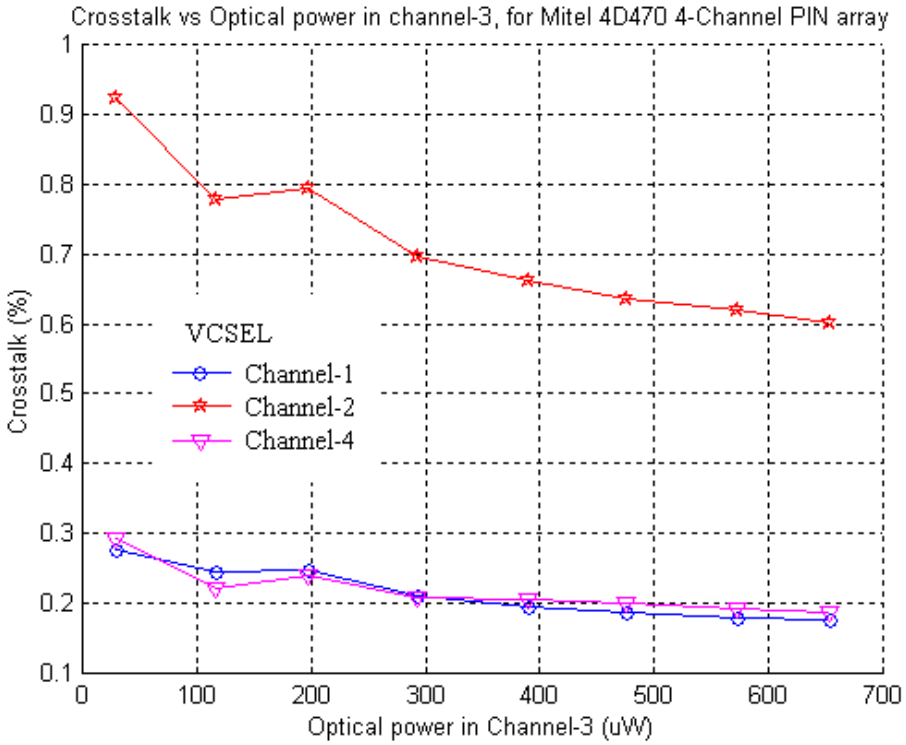

Figure 6: Crosstalk at the channels of the PIN array produced by the optical power received in the channel-3.

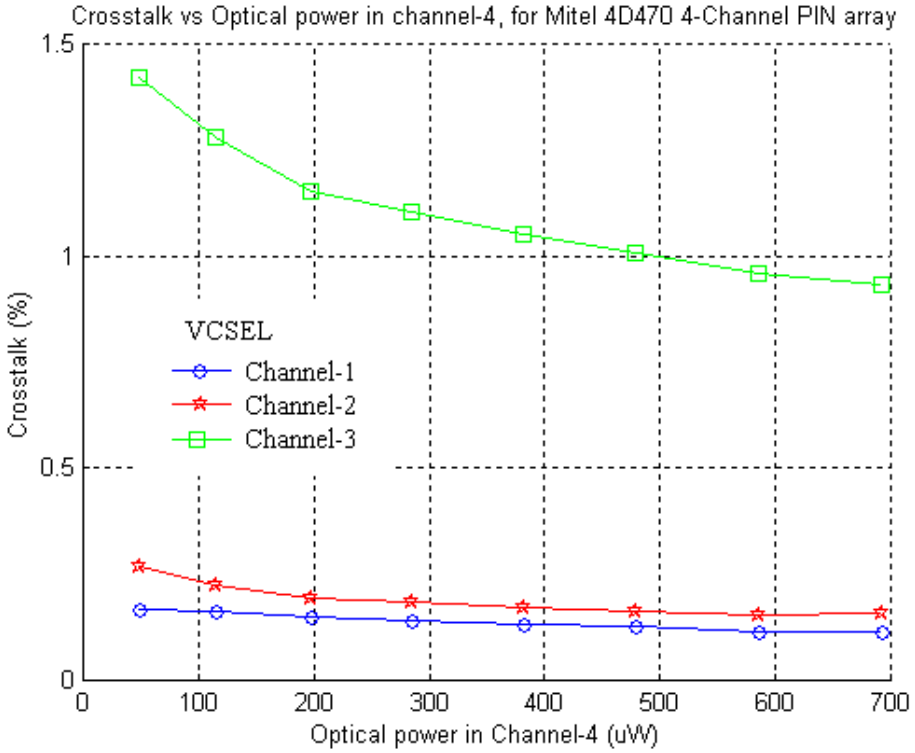

Figure 7: Crosstalk at the channels of the PIN array produced by the optical power received in the channel-4.

Tests of transmission between the Mitel 4D469 VCSEL array and Mitel 4D470 PIN array connected via MT connectors and optical fiber ribbon.

Before making the measurements about transmission between the arrays we test the noise in the oscilloscope, the test was made without any external connections, after making this test we connected the oscilloscope to the test boards and the noise did not change.

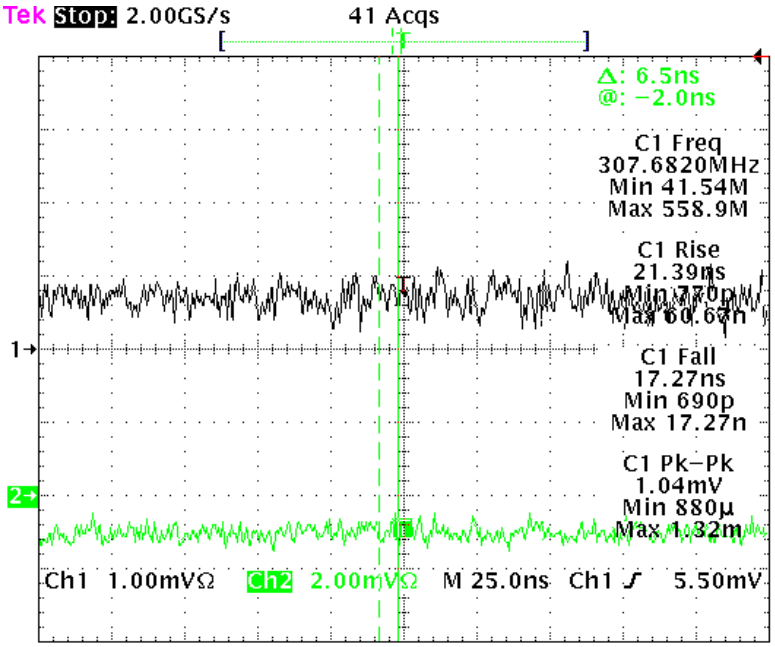

Figure 8: Measurements of noise in the oscilloscope Ch1 (black) and Ch2 (green).

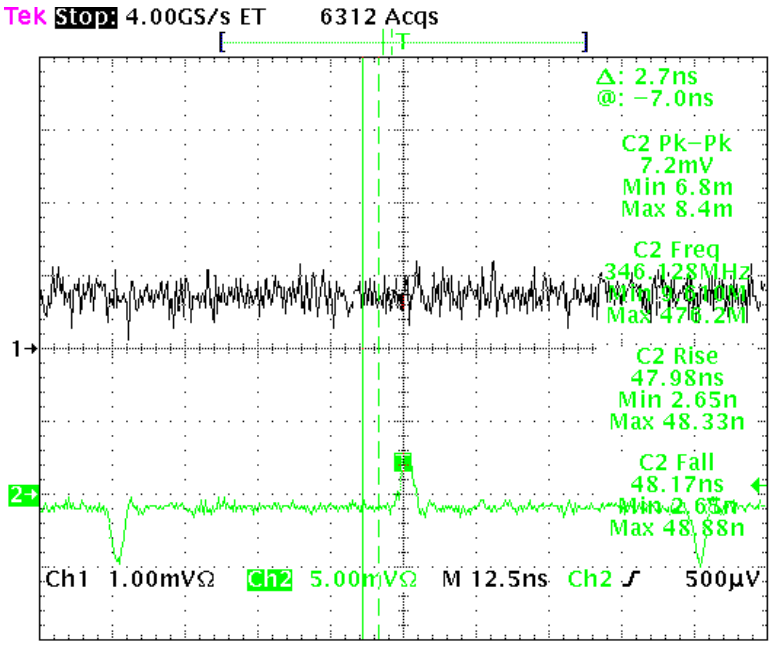

Figure 9: Noise measurement in the pulse generator (Ch2, green) with its output turned off.

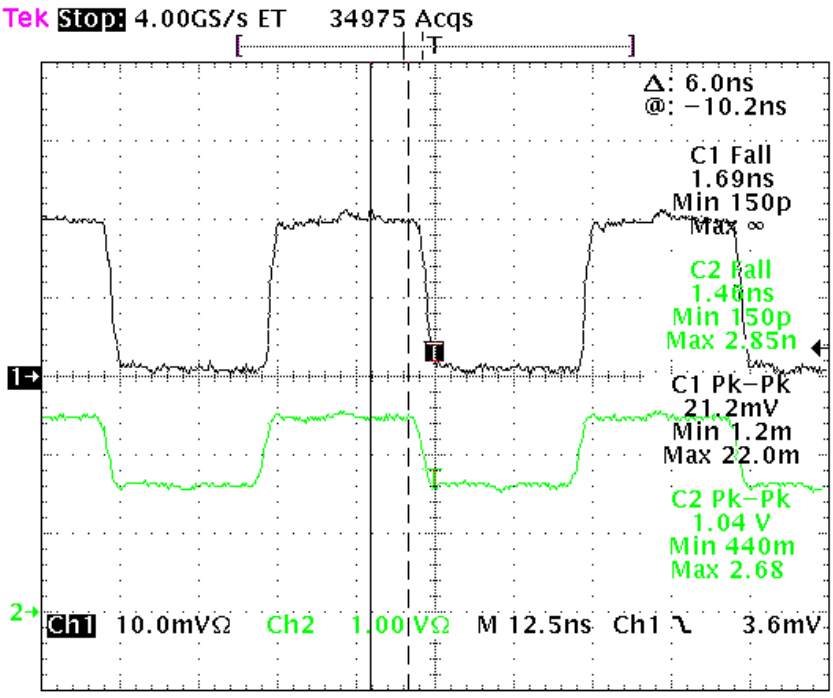

Figure 10: This picture shows another way to drive the VCSEL. The input signal is Ch2 and the output signal is Ch1. The signal driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

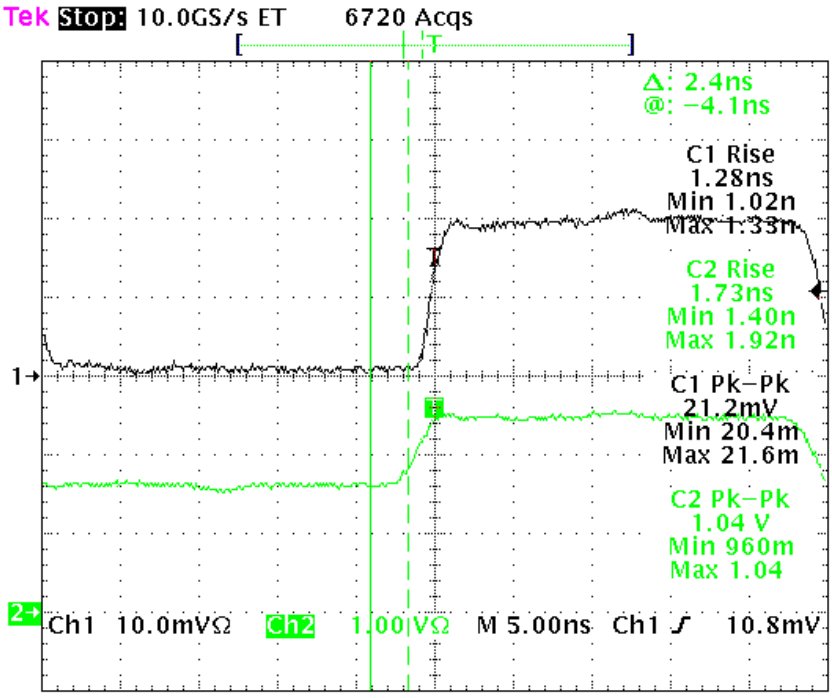

Figure 11: Measurements of rise time and peak-peak voltage from the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

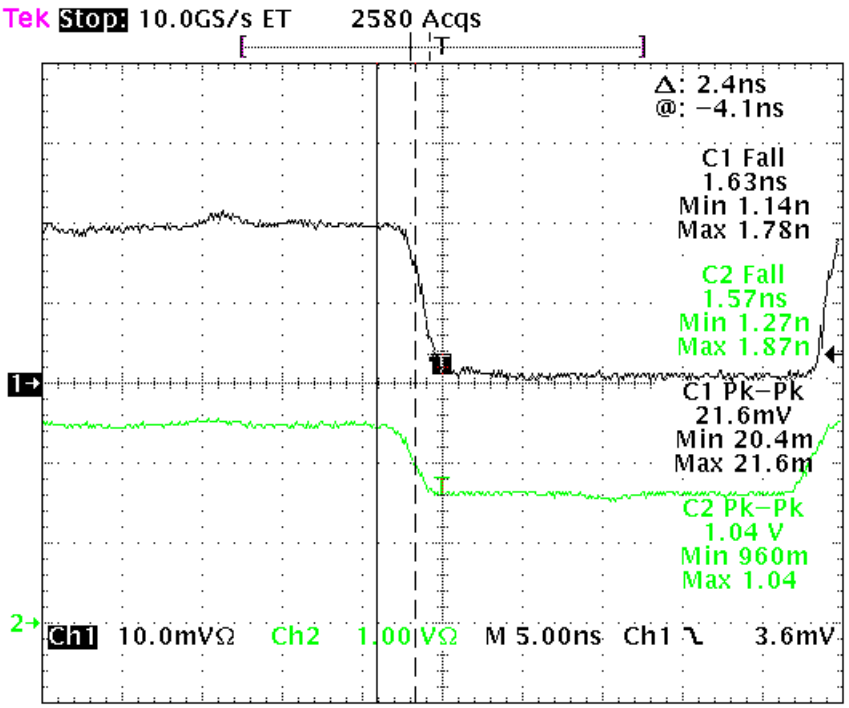

Figure 12: Measurements of fall time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

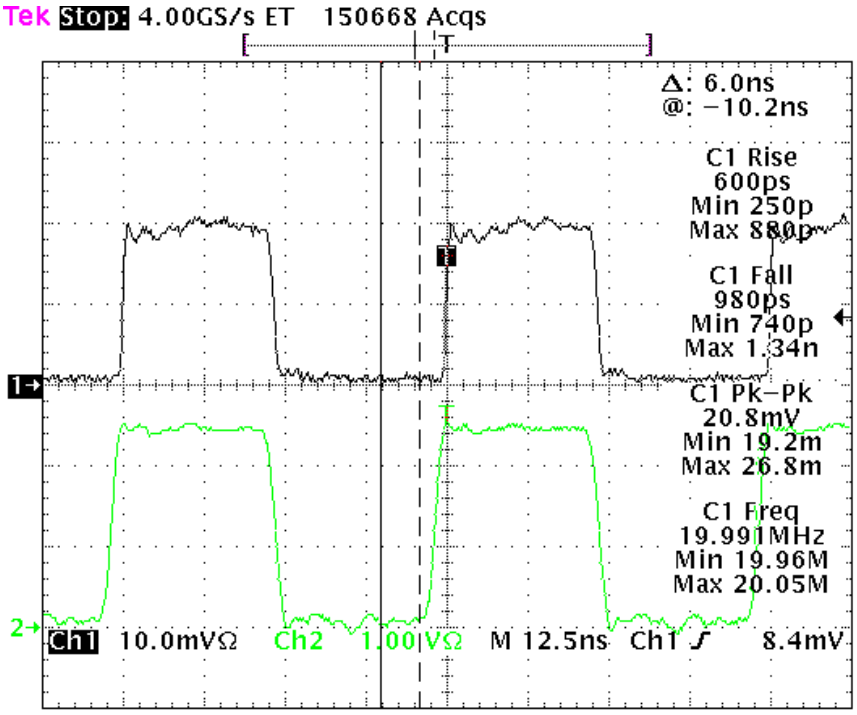

Figure 13: Measurements of the output signal (Ch1), input signal is showed on Ch2 of the oscilloscope. The signal driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

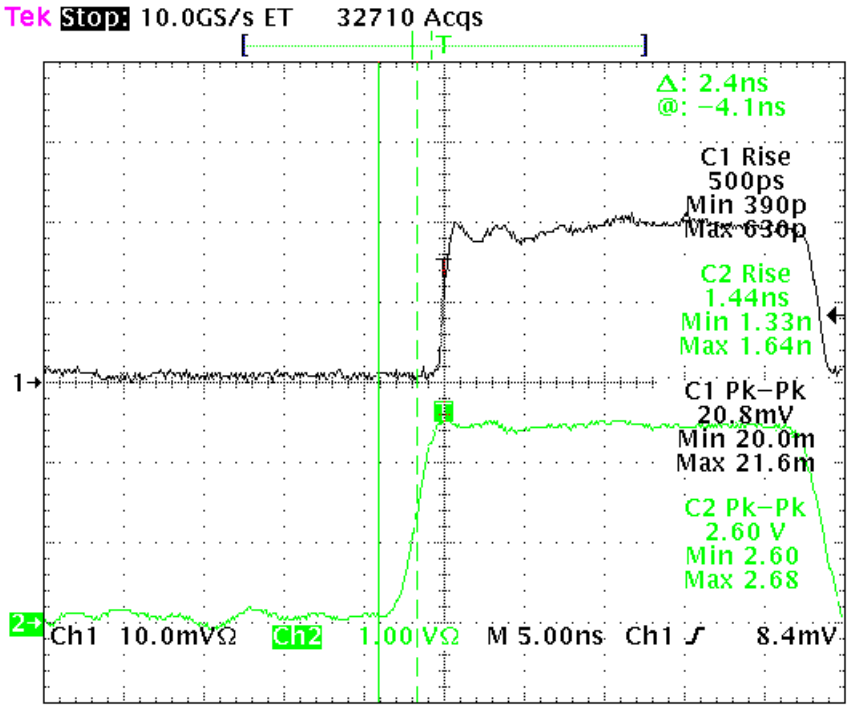

Figure 14: Measurements of rise time and peak-peak voltage from the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

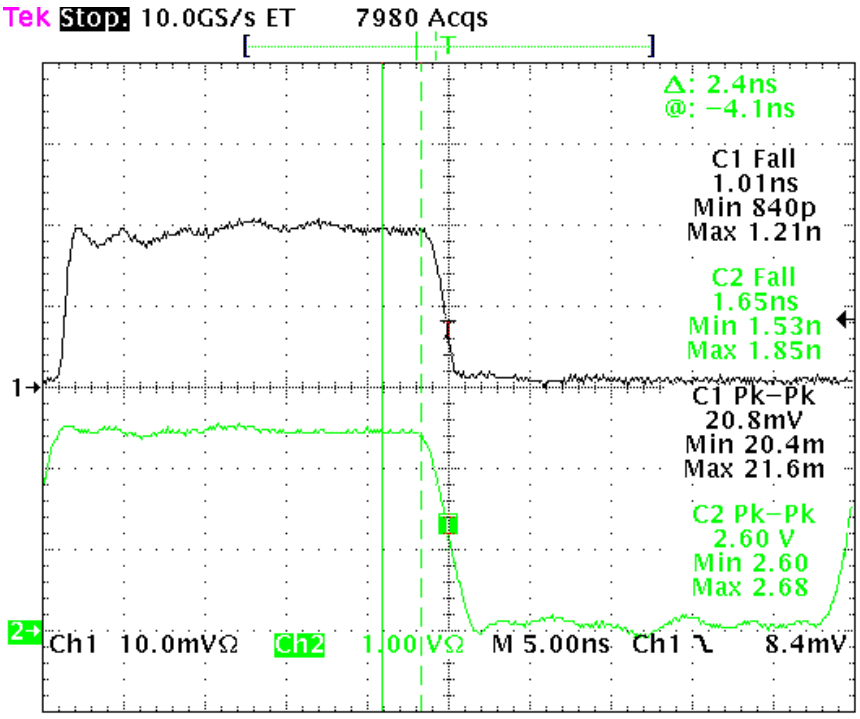

Figure 15: Measurements of fall time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

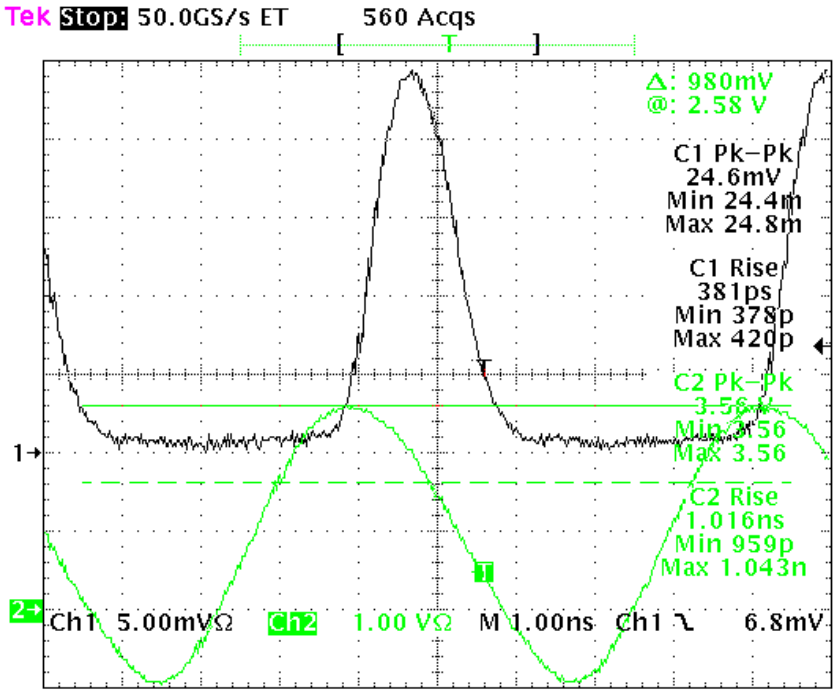

Figure 16: Measurements of rise time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL1 is on Ch2 (input signal) and the signal received from the PIN photodiode 1 is Ch1 (output signal).

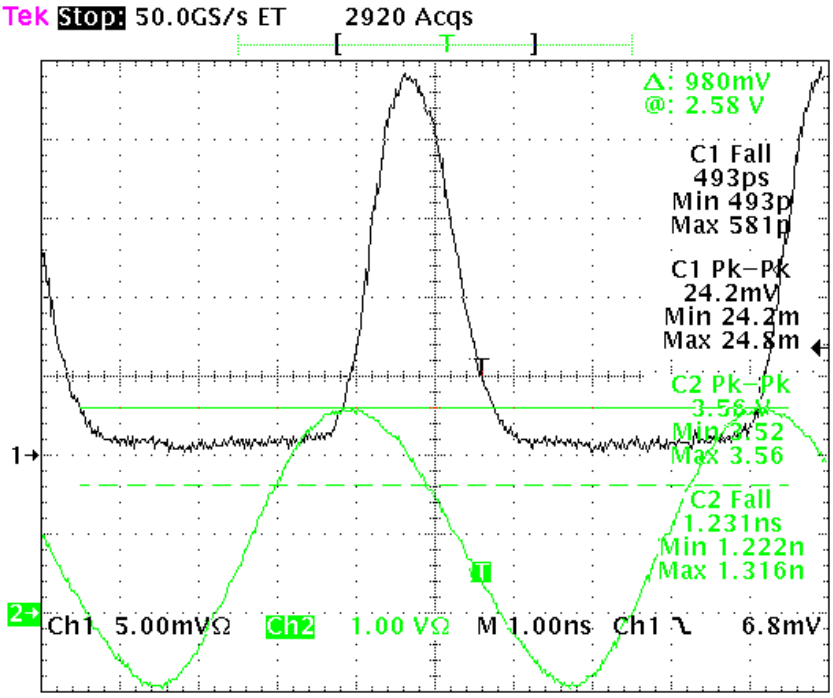

Figure 17: Measurements of fall time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL1 is Ch2 (input signal) and the signal received from the PIN photodiode 1 is Ch1 (output signal).

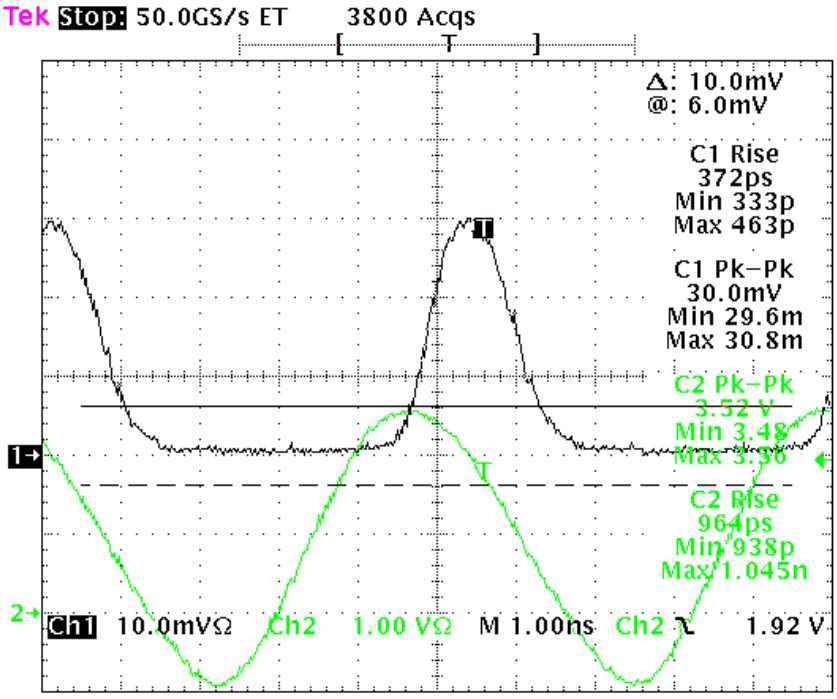

Figure 18: Measurements of rise time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL2 in the array is Ch2 (input signal) and the signal received from the PIN photodiode 2 in the array is Ch1 (output signal).

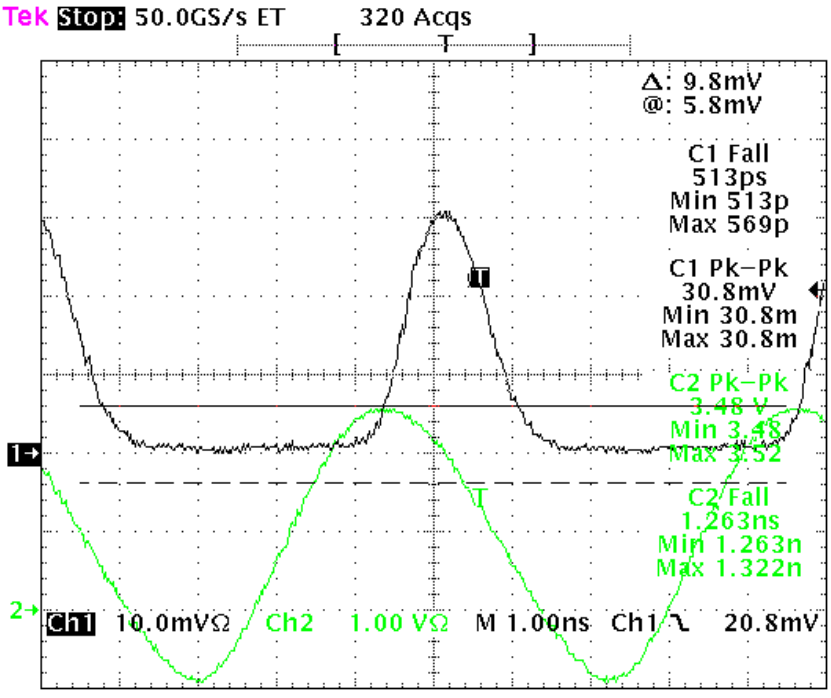

Figure 19: Measurements of fall time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL2 in the array is Ch2 (input signal) and the signal received from the PIN photodiode 2 in the array is Ch1 (output signal).

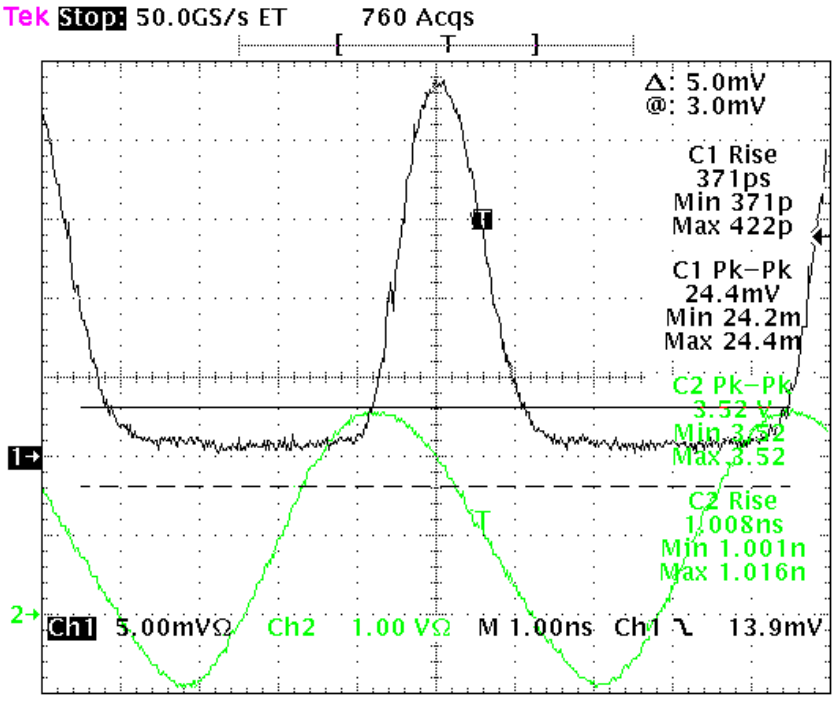

Figure 20: Measurements of rise time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL3 in the array is Ch2 (input signal) and the signal received from the PIN photodiode 3 in the array is Ch1 (output signal).

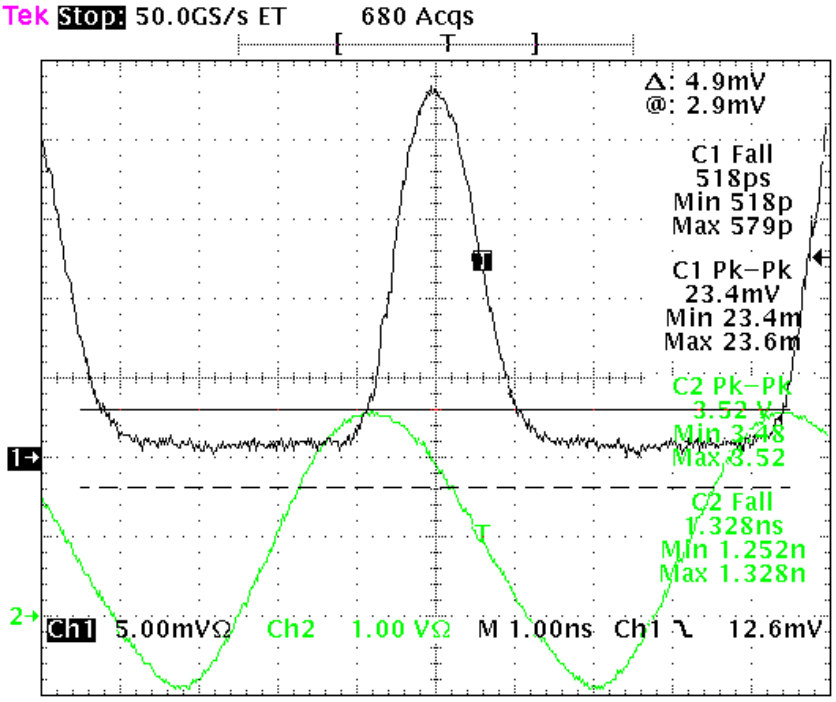

Figure 21: Measurements of fall time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL3 in the array is Ch2 (input signal) and the signal received from the PIN photodiode 3 in the array is Ch1 (output signal).

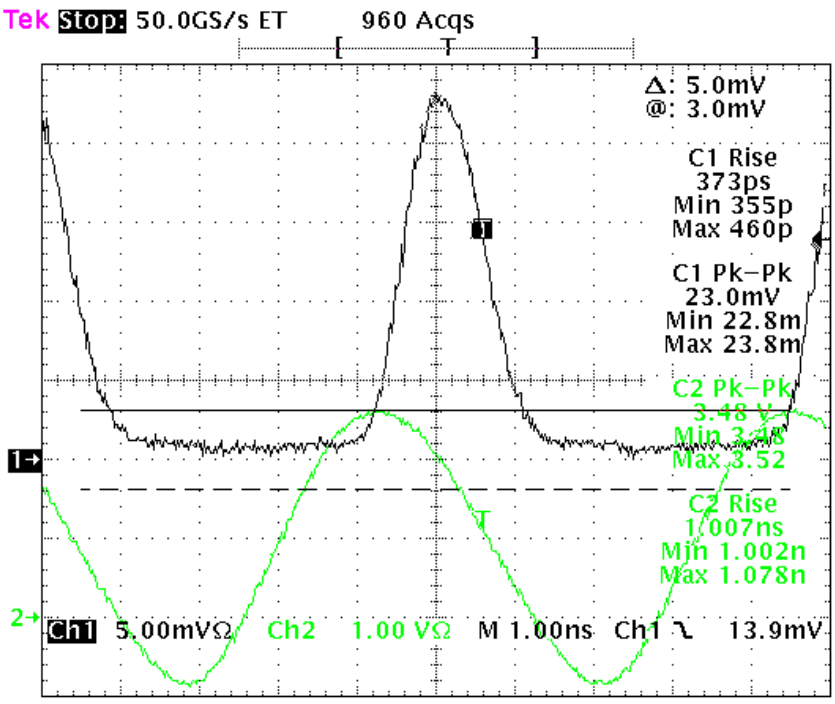

Figure 22: Measurements of rise time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL4 in the array is Ch2 (input signal) and the signal received from the PIN photodiode 4 in the array is Ch1 (output signal).

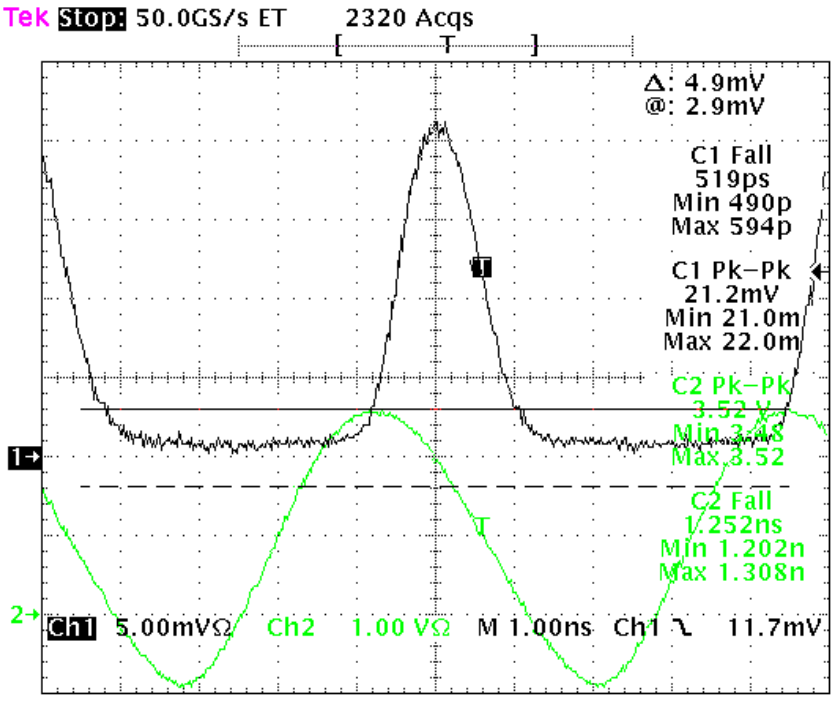

Figure 23: Measurements of fall time for the output (Ch1) and input (Ch2) signals. The signal driving the VCSEL4 in the array is Ch2 (input signal) and the signal received from the PIN photodiode 4 in the array is Ch1 (output signal).

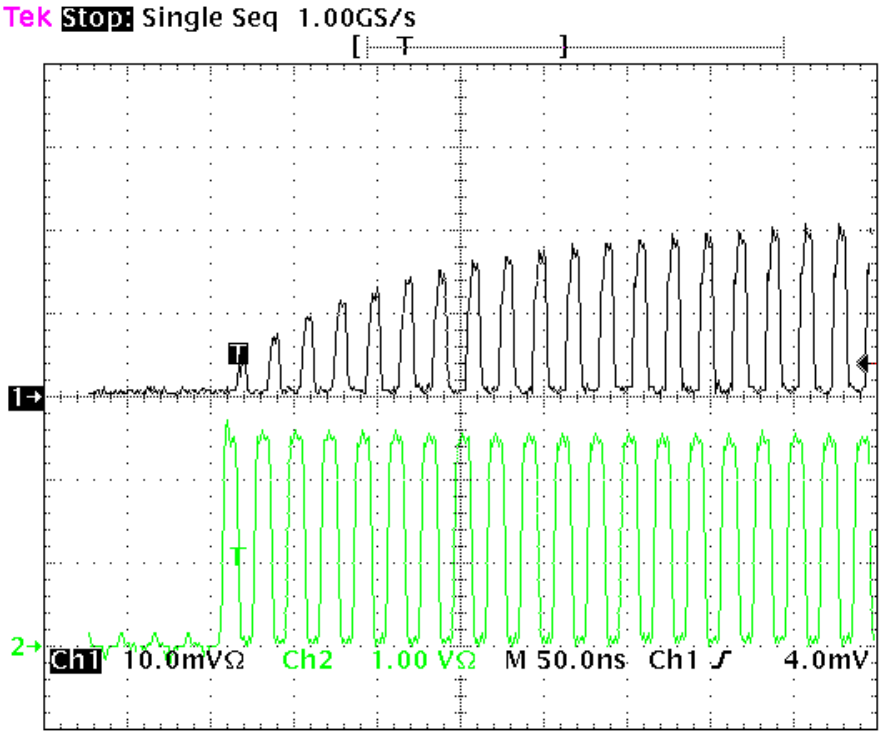

Figure 24: Measurements of the transient in the VCSEL. The signal that it is driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

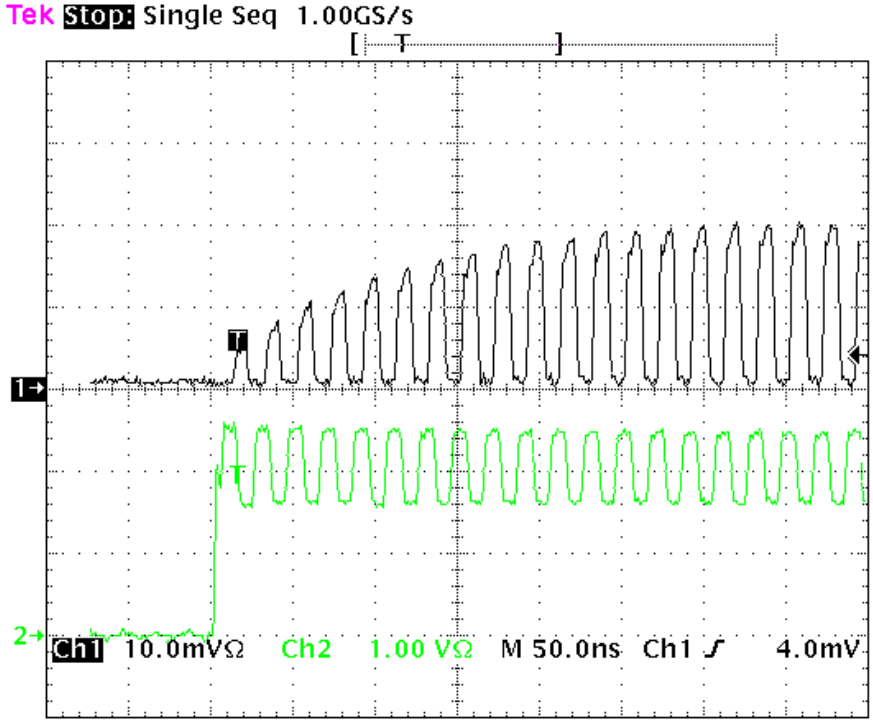

Figure 25: Measurements of the transient in the VCSEL. The signal that it is driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

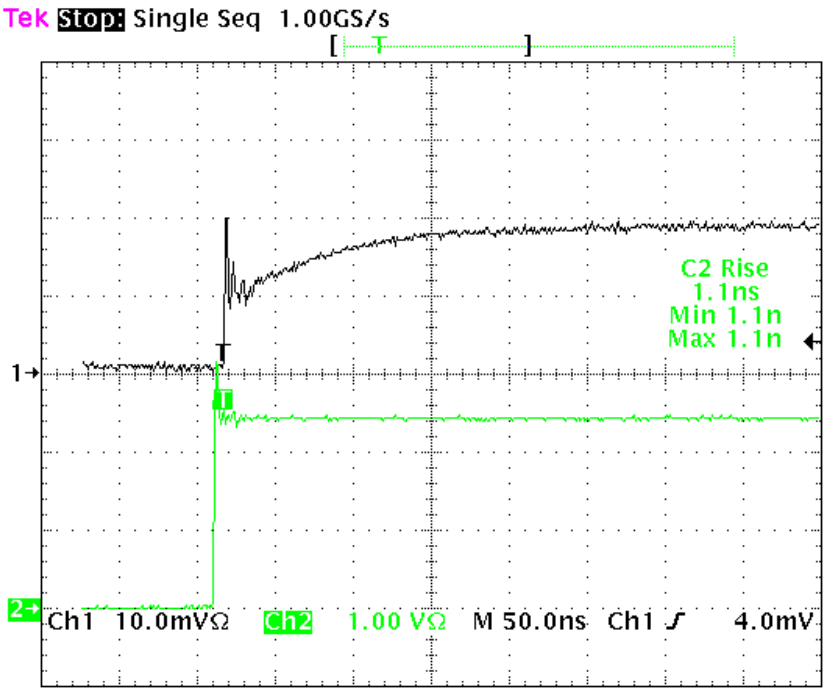

Figure 26: Measurements of the transient in the VCSEL. The signal driving the VCSEL is Ch2 (input signal) and the signal received from the PIN photodiode is Ch1 (output signal).

Conclusions

Each VCSEL in the array shows a very stable relationship between its current and voltage. The VCSEL array's average resistance is 52Ω. The relationship between the optical power delivered from the VCSEL and its current is stable.

The VCSEL need 300ns after turned on to deliver a stable signal.

The transmission test looked at the lowest rise and fall time. We used three different signals to drive the VCSEL. Pulses of about 381ps of rise time and about 493ps of fall time were measured in the four channels of the array.

The highest crosstalk in the PIN array was –18 dB or 1.4%.

The crosstalk test shows some misalignment in the assembly since channels 1 and 3 have different crostalk when light is entered through fiber 2. Also, channels 2 and 4 have different crostalk when light is entered through fiber 3.

The optical power is degraded after the MT-12 connector has been plugged and unplugged a couple of times. We will run a test on this problem.